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ABSTRACT

This report of the 1978 activities of the Australian Society of Educational Technology includes reports, articles, a state of the art review, and a technical report. Section I lists the memberships of the national executive and state chapter council, and presents a national report and reports from four state chapters. Three articles are presented in Section II: Floyd and Lynna Ausburn examine perception skills and memory for visual images; D.J. Magin discusses educational technology in terms of the concept of the missing curriculum; Ian D. Thomas sets educational media in perspective as only one consideration among many in the education process. In Section III, a state of the art review by Donald P. Ely presents the evolution of educational technology leading to the establishment of an identity for the field and indicates possible future directions. Included is a brief discussion of some of the historical roots, contributing fields, current practices, and future issues. A technical report by Nancy D. Lane in Section IV examines microforms as tools for learning, reviewing their educational applications, outlining the major types of micrographics equipment available and their costs, and describing sample equipment configurations. (CMV)

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AUSTRALIAN SOCIETY OF EDUCATIONAL TECHNOLOGY

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YEAR BOOK

1978

AUSTRALIAN SOCIETY OF EDUCATIONAL TECHNOLOGY

YEARBOOK 1978

Edited by Robert A. Cannon

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1978

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AUSTRALIAN
SOCIETY OF
EDUCATIONAL
TECHNOLOGY

NATIONAL EXECUTIVE FOR 1978

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AUSTRALIAN SOCIETY OF EDUCATIONAL TECHNOLOGY

NATIONAL REPORT

Deane W. Hutton
National President

The Australian Society of Educational Technology had its third birthday in March, 1978. However, as a three-year-old it was a very different animal from the one which celebrated its second birthday a year earlier. In a year it evolved into almost a new species. The South Australian Chapter of ASET *was* the Australian Society of Educational Technology in March 1977, but today it is just one state chapter in a family of four. 1977 saw the birth of the Victorian and New South Wales state chapters and in March, 1978 Queensland gave birth to the fourth state chapter of ASET. The South Australian Chapter, with its somewhat presumptuous title of *Australian* Society of Educational Technology, is no longer unique. It is now a member of a growing family, which is exactly what those of us who anguished over titles, definitions and a constitution, in Adelaide, back in 1975 hoped for.

We can now say, across Australia, that 1977 was a year of co-operation for ASET - both between interstate groups and with other associations and organizations within each of the four states which are now involved.

In my estimation, the growth period between March, 1977 and March,1978 was punctuated by at least five very significant meetings that have influenced the development of ASET on the national level. These meetings were:

1. June 2, 1977
   Victorian Chapter Inaugural Meeting
   Victorian President elected - Mr. Alex Millar, State College of Victoria (Toorak)

2. June 8, 1977
   South Australian Council met with two Victorian Council members

in Adelaide

3. July 12, 1977
   First meeting of National Executive in Canberra
   National President elected - Dr. Deane Hutton (South Australia)
   National Secretary elected - Mr. Robert Miller (South Australia)

4. October 17, 1977
   New South Wales Chapter Inaugural Meeting
   New South Wales President elected - Mr. Maxwell Ward, Cumberland College of Health Sciences

5. March 15, 1978
   Queensland Steering Committee formed to work on constitution and to plan first annual general meeting
   Chairman elected - Mr. Geoffrey Roberts, Mount Gravatt College of Advanced Education

The number of people actively involved in ASET activities around Australia grew from 70 to 250 in a period of 12 months. A national roll call would now look something like this:

South Australia	70 members
Victoria	105 members
New South Wales	45 members
Queensland	30 participants
TOTAL	250

At the outset, we defined Educational Technology as:
the design, application, evaluation and development of systems, methods and materials to improve the process of human learning.
This very broad definition has meant that the 250 people involved in ASET represent a broad spectrum of educational interests. Members include practising educational technologists, media specialists and librarians from primary, secondary and tertiary institutions. We also

have lecturers, advisory teachers, educational administrators, classroom teachers and representatives of commercial firms. Our growth has paralleled the expansion of educational technology centres in state education departments and the development of tertiary education units in universities and colleges of advanced education. In this time, we have also seen the commencement of several graduate diploma courses in educational technology across Australia. Many people from these growth activities have been intimately involved in the formation of our national Society and instrumental in helping ASET to maintain a broad view of the field.

Our national constitution lists the first two objects of ASET as:

(1) to provide for a fellowship of persons engaged in and persons interested in educational technology; and
(2) to provide a forum to exchange, question or promote ideas or practices within the field of educational technology.

We have certainly made a start in achieving these objects, but we still have a long way to go. As a national body, we need to encourage the nuclear groups in the remaining states which are currently contemplating the difficulties of gestation and the pangs of birth. Also, perhaps we should now be considering what contributions we can make to the field of educational technology on an *international* scale!

NEW SOUTH WALES CHAPTER REPORT

Maxwell Ward
Chapter President

On Monday, 17 October, 1977 an open meeting was held at the New South Wales Institute of Technology where the working party of Robin Bishop, Bill Robertson, Dean Gedling, Leslie Muir, Brian Flynn, Alistair Innes, Andrew Greig and Max Ward outlined the history of Audio Visual Advisory Committee of New South Wales and the wish to form a New South Wales Chapter of ASET together with procedures to do this. A videotaped message from the national President, Dr. Deane Hutton, was played via a television projector to those in attendance.

After considerable discussion, an interim membership was offered. This preceded an election of an interim steering committee to draw up a constitution and to suggest a joining and annual fee.

In January, 1978 the proposed constitution was sent to all interested parties and an Annual General Meeting was called on March 20, 1978. The Interim Steering Committee reported its recommendations. These were accepted, an election for the Foundation Council took place and the Chapter came into being.

A newsletter has been published which lets members know of the happenings of the Chapter. The first edition of the Higher Education Learning Program Survey Australia catalogue has been put together through the hard work of Bert Cornelius (Macquarie University) and Leslie Muir with assistance from Kay Welsh (Nepean College of Advanced Education), Bill McBain (University of New South Wales) and Robin Bishop (Australian Film and Television School).

The activities committee is in the process of arranging functions starting in September and going monthly until April, 1979.

With our first six months of preparation, the New South Wales Chapter is on the GO.

QUEENSLAND CHAPTER REPORT

Geoffrey Roberts
Chapter President

Following the circulation of a letter, a small meeting was held in March, 1978 which decided that enough interest existed to proceed with the setting up of a state chapter of ASET. A four person working committee was established which called a meeting in May to present the proposed constitution, elect an interim committee and offer an interim

membership subscription. Also at this meeting a videotape from Brunel University, England, on television programme production at tertiary level was shown, with a following discussion chaired by Mr. Neil Mudge, Supervisor of Education Programmes, ABC, Queensland. Some thirty people attended this meeting. The interim committee held the first Annual General Meeting of the state Chapter in early July at which the constitution was formally adopted, an executive for 1978/79 was formally elected and membership fees set.

The executive of the Chapter represents a fair cross-section of those interested in educational technology in Queensland. There are representatives from colleges of advanced education, secondary and primary schools, the State Department of Education and from equipment suppliers.

The executive planned a series of monthly meetings for 1978. The first meeting was held at the Queensland Conservatorium of Music. Approximately 20 people attended this meeting at which Howard Davidson, Senior Lecturer at the Conservatorium, discussed audio recording practices in education and industry. Meetings planned for the remainder of 1978 cover colour photographic processing techniques for schools, making slide/tape programmes and a proposed social gathering at Mount Gravatt College of Advanced Education for December which will also include a look at the CCTV facilities of the College and a discussion on the uses of colour microfiche in education.

The executive of the Chapter is very conscious of the size of Queensland. A substantial proportion of funds will therefore be devoted to the publishing of a newsletter for members outside the Brisbane metropolitan centre. At the tertiary level there is a university and a college of advanced education in Townsville 1,536 kms north of Brisbane, a college of advanced education in Rockhampton, 734 kms north, another college of advanced education in Toowoomba, 120 kms west, as well as substantial numbers of teachers in large towns such as Cairns, Mount Isa, Townsville, Rockhampton and nearer Brisbane on the Gold Coast strip to the south and on the Sunshine Coast area to the north

of Brisbane.

In Brisbane, the two universities and the Queensland Institute of Technology have established education research and development units. The only other college of advanced education to do this has been the Darling Downs Institute of Advanced Education. These units deal with many matters directly or indirectly related to educational technology. In 1977, the Tertiary Education Institute at the University of Queensland started producing *Labyrinth* for the Higher Education Research and Development Society of Australasia which contains a good deal of information on educational technology in higher education in Australia. The Centre for the Advancement of Learning and Teaching (CALT) at Griffith University continues to be closely connected with course development at the University and has expanded its media production facilities over the past year.

The Queensland Institute of Technology has established a Tertiary Education and Development Unit headed by Derick Unwin. This unit acts as an advisor on curriculum matters for academic staff and provides a range of technical production facilities. Purpose built accommodation in the Institute's new central library should see the ERDU play an important role in this institution.

None of the other colleges in Queensland have yet established similar units. The three former teacher's colleges in Brisbane have long had audio visual courses for their pre-service teaching students, while the audio visual departments have also usually carried out media production tasks for the rest of the college. Such departments are seldom, if ever, viewed by staff in the same light as the special units described previously.

The three former teachers colleges in Brisbane are now linked to a central computer facility at Kedron Park CAE. Although the computer is used heavily for administrative tasks, a start is being made on computer assisted instruction by the mathematics and science departments.

Mount Gravatt CAE now offers a course on the Technological Revolution in Education at the Bachelor of Education level with considerable stress on systematic design of instructional materials. Under a revised pre-service programme for primary and secondary teachers to start in 1979 at Mount Gravatt, the audio visual component will be incorporated into courses on the methodology and techniques of teaching. This offers the prospect of media utilization being presented as an integral component of teaching strategies and techniques. Townsville College of Advanced Education has been using conference telephone links in their Bachelor of Education programme as a means of coping with distance problems. One of the courses in this programme has been designed on a modified Keller Personalised Self-Instructional basis for both internal and external students. Both Townsville College and Mount Gravatt College have started making extensive use of audio cassettes for external students. Mount Gravatt has also found colour microfiche a convenient format to supply material to external students in disciplines like geography.

A Media Resource Centre has been established to produce software for the whole technical and further education college system and considerable sums have been spent on hardware to utilize the programmes in the various colleges. Some production facilities are also planned for each college.

The media section of the Library and Resource Services Branch of the Queensland Education Department continues to play an active role in the development of educational technology in Queensland. Over the past year, a dozen 16mm instructional films, filmstrip/tape kits, loop films and an audio tape series have been produced. There are six teachers operating in-service courses for both state and non-state teachers in media utilization. In the last year, nearly 1000 teachers participated in one of the in-service programmes. These range from week-long courses to short after-school sessions designed to suit particular school needs. Production has clustered in the four areas of support for correspondence education, resources to compensate for deficiencies

in particular subject areas, (e.g. spelling, science laboratory safety), in-service materials on new curricula and a priority country area television project to supply video cassette programmes to schools outside the ABC television reception areas.

ASET will come to play an increasingly important role in improving communication between people involved and interested in educational technology at each of the levels of education described. Distance will be a particularly significant problem in managing the affairs of this Chapter, but given the technological infrastructure already in existence, there is room for optimism and for innovation.

SOUTH AUSTRALIAN CHAPTER REPORT

Clem Latz
Chapter President

The South Australian Chapter continues to provide general meetings of interest to its members. One such meeting included a concise survey of the literature on multi-image presentations followed by the viewing of programmes produced by one of our Council members and by a local advertising agency. A very profitable question and answer session on the topic 'Why Multiscreen?' concluded the evening. Another meeting took the form of a visit to the Electrophotography Laboratory in the Department of Defence Materials Research Laboratories where the pioneering work of this laboratory in the development of Xerography was described and demonstrated.

This fourth year of existence of the South Australian Chapter will be seen in retrospect as a year of consolidation. For three years the Council has been concerned with the establishment of the Society in this state and its growth through the formation of Chapters in other states. This year in South Australia the Society's growth has reached a plateau. The Council is continuing to search for ways in which the Chapter can serve the needs of the members and is also considering ways in which it

can co-operate with other organizations having related interests by holding joint meetings. An example of this latter approach is the planned participation by the Society in a conference sponsored by the Educational Technology Centre of the South Australian Education Department which is to be held in November.

On the national level, the South Australian Chapter is organizing an Educational Technology Leadership Conference for the second weekend in October. The Educational Media Leadership Conference, held annually at Lake Okoboji in the United States of America, which has had such great influence on policy making and policy makers in educational technology in that country, provides the model for this conference. Delegates will spend three days in the delightful setting of the Raywood Centre in the Adelaide hills in study, discussion and report writing on the theme of visual literacy. The conference will also provide the opportunity for a meeting of the National Executive at which policy decisions important for the continued vigour and influence of the Society will be taken.

I wish to thank the members of the Council for their continued support and interest. It has been exciting to participate in the rapid spread of the Society over the last three years. We anticipate that the future task of consolidating and establishing the influence of the Society, while less spectacular, will be even more demanding and challenging.

VICTORIAN CHAPTER REPORT

Alex Millar
Chapter President

It is with some satisfaction that the threads of the 1977 Yearbook report on the Victorian Chapter can be taken up and neatly tied. The Interim Council, having fulfilled its function in a short, four month life, was transformed into a Foundation Council at a Special General

Meeting on September 29, 1977 at Toorak State College. The process was complicated somewhat by the constitutional procedures required for the adopting of a chapter and the national constitution, as well as the conducting of an election.

Whereas the Interim Council, of necessity found itself preoccupied with the establishing of a constitutional structure for a new organization, the Foundation Council was able to turn to the vital work of organizing a programme of activities of interest and value to the new Chapter's members. The first of these activities was an end-of-year professional and social function, appropriately called 'An Educational Technology Happening'. Significantly, the 'Happening' initially was a non-event, thanks to a state-wide power strike! However, a few weeks later, with the turbines generating, the 'Happening' happened at Swinburne College of Technology, and those attending were exposed to a range of displays of software and hardware as well as the camaraderie of a social wind-up.

The New Year was launched impressively with a well attended lecture at Toorak State College by Drs. Lyn and Floyd Ausburn, on the topic 'Visual literacy and cognitive styles'. This lecture was indeed a stimulating experience for all concerned and demonstrated how fortunate the Victorian Chapter is in having the ex-Oklahoma State University husband and wife team among its members.

Two other activities enjoyed by members this year at Melbourne State College have been a workshop on 'Computers in education' and a lecture/demonstration on 'Compressed speech', the latter being provided by Lloyd Junor.

Early in 1978, planning commenced for a one day seminar to be held in October in conjunction with the Educational Television Association of Australia and the Television Society of Australia. The seminar has been organized as part of a convention and exhibition being staged by a Sydney based group, CETIA (Computers, Electronic Technology,

Instruments and Communication). The programme is centred around educational television case studies from the ABC's schools television service and from a commercial network (the latter being conducted by Deane Hutton), while in the afternoon session, Graeme Foster, Supervisor of the Tasmanian Media Centre, will focus on the thorny question of 'Accountability and audio visual media in education today'. The day's activities will conclude with the Chapter Annual General Meeting and the annual dinner.

One of the important aspects of the Chapter's activities in 1978 has been the newsletter News. Glen Garden, the editor, has not only kept members informed of Chapter events and news, but has also been able to provide a surprising amount of interesting professional information, articles and details of technological development.

The Yearbook is rapidly establishing itself as a valued professional publication for educational technology in Australia, and Robert Cannon is to be congratulated on his achievement.

Before concluding, I would like to extend to our colleagues in South Australia, as well as in the newly formed Chapters in New South Wales and Queensland, the professional greetings of the Council and members of the Victorian Chapter.

As we approach the end of our first full year, I would like to express my sincere appreciation and gratitude to the members of the Interim and Foundation Councils and, in particular, to Secretary, David Harrison, Treasurer, John Lucas, and to Hilary Griffith and John Mitchell.

PERCEPTION SKILLS AND MEMORY FOR VISUAL IMAGES*

Floyd B. Ausburn, Lecturer in Educational Technology, Monash University

Lynna J. Ausburn, Education Co-ordinator (TAFE), Education Unit, Swinburne College of Technology

Abstract

This paper is offered as an example of research problems in the field of educational technology. It is concerned with how students' skills in visual perception are related to their ability to remember visual images. Visual memory, and factors which contribute to it, are becoming increasingly important to teachers and researchers as more and more visual instructional materials are used in classrooms.

The paper illustrates how a question is approached by researchers and illustrates the sorts of techniques which can be used to study a research question. Several research techniques and issues are explained in the paper. The specific findings and conclusions of this research study concerning relationships found between perception skills and visual memory are discussed.

Introduction

Teachers in today's classrooms are using a variety of visual materials. Students are therefore required to view, and to remember, a great deal of information presented to them via pictures, films, maps, diagrams, and other types of visual images. This leads educational researchers to be concerned with the memory retention element of learning when studying the impact and effectiveness of visual instructional materials. With visual as well as verbal materials, learners are not likely to benefit from instruction which they do not remember. Considerable interest has therefore arisen among researchers in the factors which operate in the process of the remembering of visual images.

Memory of images has been defined and studied in educational research literature in numerous ways, one of which has been the levelling/

*This paper is based on a paper presented at the Research and Theory Division sessions of the national convention of the Association for Educational Communications and Technology (AECT), April, 1978, Kansas City, U.S.A.

sharpening dimension of mental processing. This memory dimension concerns individual differences in the ability to retain and recall discrete images of a gradually changing sequence of items. When viewing a sequence of pictures, levellers tend to merge new pictures with memories of previous ones and thus construct relatively "whole" impressions of the entire sequence. Sharpeners, on the other hand, tend to maintain discrete impressions and memories of separate pictures in the sequence so that elements retain their individuality. Thus, sharpeners would be said to have a more accurate visual memory than levellers. While levelling/sharpening has been demonstrated to operate in learning a series of words as well as pictures (Gardner and Long, 1960) and in recall of verbal story material (Berkowitz, 1957; Holzman and Gardner, 1960), it has primarily been studied in relationship to visual (i.e. pictorial) material. Since it has been relatively well identified and supported by research, levelling/sharpening was selected as the variable representing memory for visual images for this study.

Several types of variables might be predicted to be related to memory performance with visual images. One group of intuitively related variables are those concerning visual perception skills. A logical question is "What relationship is there between skills is *perceiving* images and the ability or tendency to *remember* them?" In the particular case of levelling/sharpening memory performance, involving a gradually changing sequence of images, it would seem that perception skills concerned with speed and accuracy in scanning, analyzing, and integrating image details or elements might be important. The purpose of this study was to examine the relationships between three selected variables of analysis/integration skill in visual perception and the levelling/sharpening aspect of memory of sequential visual images.

Research procedures

Subjects. The subjects for this study were a group of 206 volunteers enrolled in teacher-training courses at a large university. This sample contained a ratio of females to males of approximately 2.3 to

one and a total of 12 individuals of racial minorities. No attempt was made to examine or control for differences in perceptual functioning and patterns between male and female subjects or between the Caucasian racial majority and ethnic minorities. Since some differences in perceptual performance have been observed between these groups and since the sample used was not drawn at random, this may have had some bearing on the results of the study which was not accounted for in the data analysis.

The subjects were not tested for visual handicaps. However, all subjects were questioned concerning such handicaps, and all reported that they had none except those ameliorated by corrective optics. It was assumed, on this basis, that all subjects were normally sighted or wore optics which gave them normal visual acuity. All subjects who reported that they wore corrective optics were required to wear them during all testing for this study.

Tests used. The subjects were given a battery of four tests: three tests of perception skills in analyzing and integrating visual figures and details, and a test of levelling/sharpening tendencies. The four tests used were the following:

1. Successive Perception Test I: This test (U.S. Army Air Corps, (1944) is a test in motion picture form which was developed for use in the World War II Aviation Psychology Program as part of the pilot selection and training program. It is now used in research to test for Lowenfeld's visual/haptic cognitive (or learning) style typology.[1] Successive Perception is concerned with the ability to observe visual figures a small portion at a time and then mentally integrate the pieces into a whole visual image. The test consists of three practice items and 35 actual test items. In each item, the subject views a pattern a small section at a time behind a moving slot and is then

[1]For general information on cognitive styles, the following article may be consulted: Ausburn, L.J. and Ausburn, F.B. Cognitive styles: some information and implications for instructional design. Educational Communication and Technology. (Formerly AV Communication Review). In press.

shown five similar variants from which must be selected the one which matches the pattern seen behind the slot. The score yielded by the test is the number of patterns correctly selected.

2. Hidden Figures Test: Hidden Figures (French, Ekstrom and Price, 1963) is frequently used to assess the cognitive style of field independence/field dependence. It requires the subject to overcome embeddedness in figure/ground perception and to locate simple geometric figures which are embedded or disguised within complex ones. The test is divided into two parts and consists of 16 or 32 items, depending on whether both parts are used. All 32 items were used in this study. The score yielded by Hidden Figures is the number of simple figures correctly located after an adjustment is made for guessing.

3. Matching Familiar Figures: This test (Kagan, 1969) is frequently used to assess the cognitive style dimension of reflectivity/impulsivity. It requires the subject to use visual analysis skills. The subject must examine a standard in the form of a black and white line drawing of a figure (such as a lion, a bed, a flower, etc.) and then look at a series of similar variants and select the one which is identical to the standard. The standard remains in the subject's view at all times, so that the test concentrates on perception skills and not on memory. The adult form of Matching Familiar Figures consists of 12 test items with eight variants per item. Scores obtained from the test are (a) total number of identification errors (representing accuracy of visual analysis and comparison), and (b) mean (i.e. "average") length of time to make a response (representing speed of visual analysis and comparison).

4. Levelling-Sharpening House Test: The test used to assess levelling/sharpening in visual memory was Santostefano's (1971) Leveling-Sharpening House Test. This test consists of 60 black line drawings of a scene containing a two-storey house with windows, a door, a weathervane, a chimney, a footpath, a fence, a cloud, a tree, and a sun. The intact picture is displayed three times. Then one element (the doorknob) is

omitted, and the picture is again shown three times. An additional element is omitted every third picture until a total of 19 elements are omitted from the original display, with the least conspicuous element eliminated first and the most conspicuous last. Each picture is displayed for five seconds. The subject is asked to tell the examiner when something looks different from the previous picture. The House Test yields three scores: (a) the point at which a change is first correctly noted, (b) a total number of correct changes reported, and (c) a "levelling-sharpening ratio", which reflects a mean (average) number of changes which go undetected. This third score was the one selected for this study. The smaller the levelling-sharpening ratio, the greater the operation of sharpening in an individual's memory of visual images. Thus, a low score on this test represented a better memory for images than a high score.

Testing Procedures. The 206 subjects were administered Successive Perception via a video tape made from the black and white motion picture version in groups ranging in size from 21 to 38 persons. Hidden Figures was given to the subjects in the same groups and at the same test sitting as the administration of Successive Perception.

Matching Familiar Figures and the Levelling/Sharpening House Test were administered individually to each subject. These two tests were given during the same sitting.

All testing was done by three examiners, using standardised instructions and scoring forms. This standardisation helped to control the introduction of differences among the examiners as potential factors influencing the scores made by subjects on the tests.

Data Analysis: The relationships among the variables were studied by applying a correlational analysis which included simple, multiple, and partial correlations. These statistical procedures are explained in the "Results" section below.

Results

The first step in analysing the data obtained on the four tests for the 206 subjects was to perform a simple Pearson correlation analysis. Simple Pearson correlation is a statistic which indicates the nature of the relatedness between two variables.[2] The relatedness is expressed as a number called a "correlation co-efficient". This co-efficient has two important properties: magnitude and direction. The "magnitude" of a correlation co-efficient shows the degree or extent of relatedness between two variables: 0 indicates no relatedness; 1 represents perfect relatedness; decimal numbers between 0 and 1 represent various degrees of relatedness, increasing in strength as 1 is approached. The "direction" of a correlation co-efficient shows whether the relatedness between two variables is positive (i.e. when one score is high, the other tends to be high as well) or negative (i.e. when one score is high, the other tends to be low).

When correlation co-efficients are calculated for every pair of variables in a group of variables being studied, the result is a "correlation matrix", in which the correlation of each variable with every other variable is shown. The correlation matrix for the five scores obtained in this study is shown in Table 1. Each variable, naturally, shows a perfect correlation (1.00) with itself, and various pairs of variables show differing magnitudes of positive and negative relationships. For example, score on Successive Perception is correlated negatively with score on the Levelling/Sharpening House Test to a magnitude of .226. This means that a high score on Successive Perception shows some tendency to accompany a low score on the House Test (remember that a low score on this test represents a high degree of sharpening).

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[2] It is important to note that correlation between two variables does *not* show that one is the *cause* of the other; it merely shows whether or not the two things are related in some way, i.e. whether or not they show a tendency to 'run together' according to some pattern. An actual causal relationship would have to be established through careful experimental research; it cannot be assumed from correlation.

The correlations in the matrix in Table 1 which are marked with asterisks are large enough to be "statistically significant". This simply means that the relationships they show are probably not limited only to the specific group of people who were tested in this study. If other groups were tested, similar types of relationships between the same two variables would probably be found. The "probably" in this statement can be made rather specific by using the probability figures shown at the bottom of Table 1.

Table 1

Correlation Matrix for all Variables

	Successive Perception	Hidden Figures	Matching Familiar Figures (Errors)	Matching Familiar Figures (Speed)	Levelling/ Sharpening House Test
Successive Perception	1.000	.575**	-.540**	.240**	-.226**
Hidden Figures		1.000	-.367**	.012	-.179*
Matching Familiar Figures (Errors)			1.000	-.596**	.189**
Matching Familiar Figures (Speed)				1.000	-.012
Levelling/ Sharpening House Test					1.000

*p <.05
**p <.01

If a correlation of a certain magnitude has a "probability" or "statistical significance" of less than .05 (written as $p<.05$), this means that there is a probability of less than five chances in 100 that this correlation would be found in the group of people who were tested when, in fact, no correlation existed in other similar groups. While statistical significance requires that research results achieve a

certain magnitude, this magnitude is sometimes not large enough to be of practical importance, as will be made clear later in this paper. Thus, it is important to realise that statistical significance of results refers only to the likelihood of similar results being found in other groups of people; it does not imply that the results are important in any practical or value-related way. Practical judgment about whether research results are "important" or "meaningful" require more interpretation of the data. Statistical significance is important, however, in that it indicates whether results obtained in a study are an "accident" of the particular sample of people which was tested for a specific study, or whether similar results would be likely to occur in other groups as well.

The correlation matrix in Table 1 shows several correlations which are large enough to be statistically significant. Significant correlations are seen in the matrix both (a) among the perception skill variables, and (b) between three of the perception skills and the visual memory variable represented by the Levelling/ Sharpening House Test. It is appropriate to first look at this second group of correlations, since these correlations show which perceptual skills are related to visual memory. Visual memory (i.e. House Test score) is seen to be related to the following perception skills, in descending order of strength of relationship:

(a) integrating partial visual images, represented by score on Successive Perception (correlation = -.226);
(b) accuracy in analysing and comparing visual details, represented by number of errors on Matching Familiar Figures (correlation = .189);
(c) separating figure from embedding ground, represented by score on Hidden Figures (correlation = -.179).

These correlations show that people who were sharpeners in visual memory (i.e. made *low* scores on the House Test) showed some tendency to be good at integrating partial images (i.e. make high scores on Successive Perception), to be accurate in analysing and comparing

visual details (i.e. make few errors on Matching Familiar Figures), and to be good at separating figures from background (i.e. make high scores on Hidden Figures).

This information, while it is useful in analysing the relationships between perception skills and memory for visual images, needs to be extended in order to gain additional important information about how perception is related to visual memory. As one follow-up measure, a "multiple correlation co-efficient" was calculated, which showed the total correlation of all four of the perception skills, as a group, to the memory variable. This group correlation was found to be .26, which was statistically significant ($p = .01$).

The next important step was to examine correlations among the perception skills themselves and how these might affect their relationships to visual memory. As can be seen in the correlation matrix in Table 1, the score on Successive Perception was the perception variable which was most strongly correlated with the levelling/sharpening memory variable. It can also be seen that the Matching Familiar Figures error score and the Hidden Figures score are both considerably related to the Successive Perception score as well as to the memory score. This suggests that their apparent relationship with visual memory occurred, at least partially, because of their correlation with Successive Perception. To test this idea, "partial correlations" were used. This type of correlation calculates the degree of relationship between two variables after the effects of a third variable to which they are both related is removed. When the effects of Successive Perception were removed, the remaining partial correlations of both the score on Hidden Figures with the memory score on the House Test dropped below a magnitude of .10. This indicated that the observed relationships between the visual memory variable represented by the House Test and the perception skills represented by score on Hidden Figures and errors on Matching Familiar Figures can be attributed primarily to their mutual relationships with the perceptual skill of integration of visual details represented by score on Successive Perception.

In summary, three important things were discovered about relationships between perception skills and visual memory through correlational analysis. First, the four perception skills measured in this study were, as a group, found to be related to levelling/sharpening in memory for visual images to a degree that was statistically significant. Second, three of the perceptual skills measured were found to be individually related to visual memory to a degree that was statistically significant. Finally, the primary perception skill found to be related to memory was the ability to integrate visual elements into whole images; the other perception skills appear to be related to memory through mutual relationships with this integration skill.

As a final analysis step, it was necessary to determine if the perception skills were related to visual memory to a degree which was great enough to make them major or important factors bearing on memory performance. To determine this, the multiple correlation co-efficient, discussed above, of .26 was used. This co-efficient was squared, producing a figure of .07. This number is a very useful statistic called a "co-efficient of determination". It means that individual differences among the people tested on a combination of all four of the perception skills used in this study could account for only 7% of the amount of individual differences in their performance on the visual memory test. This leaves 93% of the differences, or "variance", in memory performance which must be related to some other factors.

Conclusions

It was concluded from this research that the perception skills tested were probably related to memory for visual images, in other groups as well as in the group that was tested. However, this relationship was not great enough to be a major factor in visual memory ability, and much of the differences in students' ability to remember visual images appears to be unrelated to the perception skills of analysing and integrating visual elements which were tested in this study. There are other factors which might be important contributors to visual memory ability, including:

(a) relationships with other perception skills not tested here;
(b) relationships with other types of variables not tested here (attention, interest, etc.);
(c) a largely independent "memory organisation" pattern in individuals.

It is suggested that further studies be conducted in order to examine these possibilities.

This research suggests that perhaps there is more involved in helping students remember what they see in visual materials than just the careful design of these materials. Even if shown well-designed visuals which aid in the perception of their components and messages, some students may still have difficulty remembering the information they contain. It might be that personality or psychological factors within some students hinder visual memory. It is possible that specialised training in "reading" visual messages and in mental structuring and ordering of visual elements might help some students remember visual material. A great deal more needs to be learned about how and why individuals vary in their aptitude for visual memory, about what instructional designs might promote visual memory, and about training for students which might help them improve their visual memory. By being knowledgeable about research relating to visual memory and by testing promising instructional designs and visual training programs in their classrooms, teachers can contribute to the development of this knowledge and to the fostering of important visual memory skills in students.

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EDUCATIONAL TECHNOLOGY AND THE CONCEPT OF THE 'MISSING CURRICULUM'

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Introduction

Educational technologists often take care to stress that 'educational technology' is not simply a term to describe the tools or hardware of instruction. It is seen to have a far more inclusive meaning which embraces the study of systems of instruction, especially with respect to those principles of learning and the organization of teaching which take account of the role of instructional tools in the educational enterprise.

Nonetheless, a good many teachers in tertiary institutions, unaware of such definitions, still think of 'educational technologies' as simply referring to the hardware or 'things' of instruction, and to guides for their appropriate use. In this common sense of the term, educational technologies are looked on as tools which increase to a greater or lesser degree the effectiveness or efficiency of instruction. Over the last few years, however, it has become apparent that the utilization of educational technologies often have a much more penetrative effect, and that many of our assumptions about their role in the teaching and learning process do not take sufficient account of their special impact on the course in which they are to be introduced.

This paper presents evidence, from examples at the University of New South Wales, of the impact of educational technologies on various curricula, and on projected curriculum reform. It is argued that the existence and use of such technologies can reach beyond being tools which simply provide assistance in instruction and can often, without our conscious foreknowledge, have considerable effect on the curriculum itself.

Most of the examples and illustrations are drawn from engineering education and are concentrated in large part on the educational uses of interactive computing.

Of recent origin as an instructional tool, interactive computing provisions are, it is contended, the most dramatic and significant of such innovations. In describing the evaluation of computer use for teaching purposes, Sir Eric Ashby (1974) referred to this as the 'Fourth Revolution' in instructional technology and saw it as becoming central to instruction in tertiary education. Many of us now are similarly convinced of the power and the capability of today's educational technology, especially that of on-line interactive computing. What seems arresting and peculiar is that there appears little evidence of the successful applications of educational technologies in institutes and universities in Australia.

Why is this so? Why has there not been a rapid take-up of the opportunities promised by technology? The following two propositions are advanced as an approach to the consideration of this issue:

Two propositions

Proposition 1

Innovations in educational technology can ofter act, in themselves, as agents of change in the curriculum; cannot only cause radical change in the process by which learning occurs (and in ways often quite unanticipated), but can often effect pervasive changes in content, i.e. the syllabus.

Proposition 2

That as teachers and curriculum developers, we should look at educational technology from the point of view of how it can be used to realise new objectives, new learning experiences unattainable by traditional instructional methods; and that we deliberately set about employing new educational technologies to actively and consciously transform the curriculum.

Effects on process

An important aspect of the first proposition is the claim that the adoption of a new educational technology (and again I am simply referring to the 'hardware' of instruction) often results in unanticipated changes in the educational process for which it is designed to serve. This claim is supported by the following instances from the University of New South Wales.

(1) In 1975 the availability of a Wang desk-top minicomputer in an undergraduate engineering laboratory prompted two of the Engineering faculty involved in teaching experimental engineering to investigage ways of employing the minicomputer to improve the teaching effectiveness of laboratory experiments (Magin, et al, 1976). Initially, it was anticipated that the use of a minicomputer would increase the efficiency of students' laboratory work by reducing the time required by students in data reduction and analysis - these aspects of experimentation being seen as essentially peripheral to the major goals of laboratory work in an experimental engineering course. Yet, when we came to observe students' laboratory work and inspect their reports, it was apparent that for a number of experiments in this course, the major part of these students' intellectual efforts were concerned with this very aspect - data reduction and analysis. The essential aspects of experimentation (as the investigators saw them) - of knowing *what* to measure, *how* to measure, and in general how to plan and validate experimental procedures - were, for the most part, not seen by students as important or problematic, since it had been usual practice for staff to provide procedural instructions and personal guidance for these.

The innovation of employing a minicomputer for analysis (and instant feedback of transformed data) provided the stimulus and capability for re-directing attention to experimentation itself, whilst the students were working in the laboratory.

A pilot study of students' laboratory performance in 1975, and an evaluation of their reactions to the changed format indicated that behaviour was indeed changed by the innovation (and changed requirements) and that students were highly conscious of the particular laboratory exercise's essential difference from other experiments in the course. On the basis of the pilot study the laboratory course in experimental engineering in 1976 was redesigned to focus on the previously underemphasised skills of experimentation.

In retrospect, what impressed the investigators was that what started out as an exploration of the use of a new educational technology in increasing efficiency in fact lead to a review, and change of emphasis, in the goals of the teaching process. Not only was this outcome not originally anticipated, but the investigators found a certain irony in the fact that the use of the minicomputer - which prompted the changes - is not now seen by them as always essential to the new approach in experimentation.

(2) A second example: the use of automated marking (through optical scanning of appropriate answer sheets) was seen as a desirable innovation at the University of New South Wales because it not only provided rapid and inexpensive processing for assessment purposes, but also provided the means for a useful diagnostic function (by allowing rapid feedback of achievement to students) at times other than near the end of the course.

As many students have discovered, however, the use of this technology for continuous assessment can often result in more assessment. Also, assessments of this kind easily lend themselves to influencing the direction of teaching and learning towards being able to select a correct response from a specified range of alternatives. Of course, this need not necessarily result and, even so, it may well be a desired outcome which articulates with some of the goals of a particular course of instruction. But one

suspects that in many instances lecturers who employ this technology are quite unaware that its adoption has actually altered students' learning strategies and behaviour.

(3) And third, a further example involving the use of the optical scanner: a colleague in the fuel technology department decided to use computer marking of quizzes in incorporating a variant of the standard multiple-choice format. The variant he used was to assign differential 'weightings' to the various distractors according to the 'degree of correctness' of each as solutions to fuel technology problems. (The 'weights' used were typically 3, 2, 1 and 0.)

He had intended to use this technique to increase the *reliability* of the test (since they, in theory, provide more information than that provided by a standard format). The result was that increased reliability was marginal, but that students now began to ask *why* one answer was weighted '3', another '2', another '1', and so on. He now consciously uses this technique as a *teaching device* rather than primarily as an assessment.

A number of other examples could be instanced to support this first proposition. To many the assertion may not be surprising, and to some even unexceptionable. Nonetheless, it would appear a too little appreciated assertion than an educational technology does not simply act to improve the efficiency or effectiveness of the teaching-learning processes, but that it reaches beyond to influence the character and substance of the processes themselves. If we think of curriculum in the wider sense - as embodying all the learning experiences which are organised and planned as part of a course of instruction - it is quite justifiable to claim that innovations in educational technology exert their own impetus for curriculum change.

Effect on content

A far more contentious issue is that of the extent to which an

innovation in educational technology can affect the *content*, or syllabus of a course. Consider the following proposition - a proposition which many may regard as a truism;

Regardless of their desirability, those skills and competencies which cannot be successfully taught or adequately developed in a course of instruction have no place in the objectives of that course.

It can be said that this is simply stating the obvious. One cannot expect students to achieve what is manifestly not achievable. But there are reasons for bringing this to attention. Let me illustrate with respect to engineering education.

In recent years a rhetoric about engineering education curricula has been making itself heard. It is a rhetoric that calls for engineering education to become real-problem oriented, instead of knowledge-discipline oriented (Dixon and Nelson, 1973); that points to the need for teaching for physical understanding (Hammond, 1969); that says that one learns best about engineering by *doing* engineering (Forrester, 1970). For some time, engineering academics in Australia have been saying similar things, using slogans such as put engineering back into engineering courses and more hands-on experience in earlier years. Whatever the meaning behind such slogans, they are nonetheless indicative of a ground swell of discontent with present curricula and indeed, over the last year or so, there have been stirrings - at the University of New South Wales and elsewhere - towards substantial curriculum reforms. It is my opinion that the views as expressed above have been little acted upon because *no realisable way* has been developed for the successful implementation and integration of this new perspective. Until recently the chance of achieving many of these desired capabilities in engineering graduates has been seen as a fond hope rather than a practical possibility in undergraduate education.

Of particular relevance to this felt need has been the introduction and increasing availability of on-line remote computing facilities (in which students participate in dynamic interaction with models of

engineering systems). These have the potential to open up new areas of syllabus, new sets of course objectives not included in traditional engineering curricula.

The missing curriculum

It is argued that this comparatively new and most sophisticated of educational technologies has the potential to play an instrumental role in bringing into an engineering course what the writer has come to call 'the missing curriculum'.

In engineering there is an increasing awareness of shortcomings in the curriculum: what is considered the most important of instructional objectives are not specified; what is regarded as the most desirable of graduate capabilities are never attempted. And this has come about, not because they are matters of process rather than content, nor because they are best left unstated or are incapable of precise behavioural definition, but precisely because they are considered *unteachable* in the present context of our course provisions.

Dwyer (1974) gives hint of the appropriate role of educational technologies when he suggests that we should evaluate their effectiveness, not by increased gains in learning in those areas usually achieved by traditional techniques, but by the extent to which they fill in glaring gaps in a system (of instruction).

How real is the concept of the *missing curriculum*? (Gagne,1974). If one looks at examples in engineering at the University of New South Wales, it can be shown to be quite real to judge from the direction of current changes, from present activities directed at course re-construction, and from recent expressions about what should be done if instruction is to be made successful. Listed below are some of the areas which make up this missing curriculum in the eyes of a number of engineering academics (Reizes, et al, 1974). Those which are instanced here are general enough to each relate to most areas of engineering and applied sciences.

- Order of magnitude understanding of functional relationships (especially those of a non-linear kind) through the observations and manipulation of engineering systems.

- Solution of real-world problems, ill-formulated and open-ended questions.

- Acquaintance with limitations and discontinuities of parametric variations in physical systems - especially those not easily predicted by analysis of mathematical models.

- Design of complex systems and optimization procedures, including economic analyses.

- Validation of mathematical models and algorithms against relevant data.

All of these desiderata require in part, if not in toto, student use of on-line interactive computing. This is not just because of the difficulty of, or time taken in, computation (for which batch-processing computing would be appropriate) but because these instances usually demand convergence processes; they require repeated manipulations of parameters of an appropriate model, manipulations which are guided by immediate feedback of the consequences of decisions or variations made.

Two examples

(1) In considering some specific cases of how interactive computing has brought the 'missing curriculum' into engineering courses, two case studies will be briefly outlined. The first case is drawn from Mechanical and Industrial Engineering. In 1973 the installation of a new computing system greatly expanded student access to on-line interactive computing facilities. Earlier efforts to make use of this facility to simulate systems and experiments whose physical counterparts were either beyond university resources, or whose scaled-down laboratory-experiment models did not reproduce the performances and characteristics of full-

scale systems. In this sense it was felt that many laboratory experiments were divorced from 'real' engineering systems.

The expansion of the interactive computing facility prompted further consideration of the use of simulation techniques. One of these experiments used in previous years - a simulation of pipe flow in reticulation systems - was seen to offer the potential to do much more than provide an alternative to laboratory experimentation. The lecturer responsible for teaching 'pipe-flow' in an undergraduate fluid mechanics course had expressed concern that the present lecture and tutorial provisions were not providing students with a sufficient base to develop adequate understandin, in this aspect of the course. In particular he saw that a functional understanding of 'pipe-flow' would require all three of the following:

- analysis of pipe-flow, calculation of outputs through the elaboration and manipulation of a mathematical model;
- appreciation of constraints operating in real engineering situations; practical limitations of parameters such as size and materials; and
- the appreciation of design possibilities through intersection of both of the above, i.e. an understanding of 'working systems' and the relationships operating between parameters.

Yet only the *first* of these desiderata was attempted in conventional instruction. The other two did not figure in the curriculum because, within the context of conventional provisions, they were not learnable. In the past, such lacunae in instruction had been rationalised as properly belonging to work experience after graduation. To quote from the investigations of this lecturer:

> One approach, perhaps a traditional, academic one, is that understanding can be achieved through thorough analysis of the mathematical model, that design constraints, e.g. pipe size - are technical details which properly belong to 'job experience'. It has been our experience, however, that successful manipulation of equations does not in itself produce understanding of what is being modelled in the physical system. We may foreshadow some of our findings reported later, which suggest that such successful manipulations are often quite divorced from any

real comprehension of the effect of varying certain parameters in the system. (Reizes, et al, 1974)

The introduction of the simulation exercise did provide, for the first time, learning opportunities in all three of these areas. Results previously reported (Reizes, 1974) do suggest that the approach has resulted in learning hitherto considered not feasible through conventional modes of instruction.

(2) A second example: for several years various schools of engineering at the University of New South Wales have been actively engaged in major course re-construction. One aspect common to these endeavours at course re-construction has been the commitment to provide students with more experience at 'doing engineering', a commitment to provide familiarity with and understanding of real engineering systems. An extract from a document prepared for one of these reconstruction committees indicates the perceived importance of interactive computing provisions in course content changes:

> The greatest potential of computers is their capability for the simulation of complex interacting systems. Everything an engineer does is concerned in some way with society and the environment. Computer simulation of the system enables the interactive nature of engineering consequences to be investigated. Such studies enable efficiency to be improved and possible problem areas to be highlighted for further consideration. In this way, engineers can be more effective in controlling the forces of nature for the benefit of mankind. (Svensson, 1974)

Since that time there has been considerable activity in course-reconstructions. Those changes that have been effected or decided on, and their direction indicate a trend away from 'engineering science' as traditionally conceived, and towards such activities as problem identification, modelling, decision-making - activities for which on-line interactive computing is more relevant.

It would appear that the very appreciation of the potential of on-line computing as a learning tool, the consideration of their possibilities, alters our perceptions of how curricula can be organised, and of how

engineering education should proceed.

Problems of application

The foregoing examples provide as case for the serious consideration of the second proposition mentioned in the earlier part of this article. To paraphrase that proposition:

That we look at educational technology from a view of how it can be applied to achieve new objectives, new learning experiences not attainable by traditional instruction.

Let me briefly give some instances from the University of New South Wales which indicate the fruitfulness of this approach.

The first example relates to the application of television for instructional purposes. Initial television applications involved use of closed-circuit television for the purpose of efficient mass-communication of lecture material. Results over the years could not be called spectacularly successful! Cost savings and 'effort' efficiency were dubious. Also, many of the student viewers responded negatively to the innovation - seeing them as having all the faults and none of the virtues of traditional 'live' lectures.

But video tape recording has opened up *new* learning experiences. Many of us have been aware for some years now of the value of micro-teaching in which the apprentice teacher is confronted with a portrayal of his own behaviour, and the immediate consequences of that behaviour.

At the University of New South Wales, video tape recording equipment is also being used for what can perhaps best be described as role-playing. Students in professional faculties (for example, Law and Medicine) are often involved in simulating situations within courts of law, doctor-patient encounters, client-solicitor transactions, and the like. These situations are then analysed in detail, often immediately after recording on videotape. The technique has proved particularly successful in providing understanding for the participant of

his own behaviour in such settings, and it has opened up hitherto unexplored learning experiences.

A last example relates to the use of automated techniques for making student quizzes and examinations. An example of its use has been given earlier, but to justify the use of machine-scorable test formats on the sole consideration of efficiency of marking does court trouble. In such instances, accusations of trivialization of learning may well stick. At the University of New South Wales, academics who wish to use the services of the Education Testing Centre's optical scanner for quizzes are asked to provide the Centre with sufficient information to enable the computer to provide, *for each student*, not only his result, but also a diagnostic summary indicating, for example, information sources (book and page references) guiding student reading in order to overcome weaknesses in the testee's learning. (Dunstan, 1973)

Conclusion

The examples and case-studies outlined in this article have been used to evidence that the opportunities to employ educational technology in ways which go beyond improvement or efficiency are manifold; that these new tools can be and are being used to extend learning experiences and to change the curriculum.

We have had access to these instructional tools - particularly interactive computing facilities - for some years now. Yet there is little evidence that they have had the impact predicted for these new tools - certainly nothing like that indicated by the Carnegie Commission's study of the instructional uses of computers, in which 'computing' was seen as the most significant revolution in instruction since writing. (Leveitt, 1972; Mayhew, 1973)

It can also be observed that the 'less sophisticated' instructional media are similarly under-used in our institutions - especially in the ways suggested in this paper. There are a number of reasons why academics have been reluctant to utilize the resources available to

them. To briefly list what some of these might be:

- a lack of training in the use of instructional aids, and associated with this
- lack of 'models' of their successful use in the teaching department;
- organization and preparation time required;
- the necessity of relying on others, e.g. media equipment is often not entirely under each individual teacher's control; and, finally
- a lack of appreciation of the potential of the instructional technology available.

To this final point, many teachers express a doubt as to the increased effectiveness of using these new tools. Studies have often proved inconclusive, or point to marginal increases in learning efficiency; the case of closed circuit television is one example.

What is required is that teachers look at educational technology from a different perspective, that they come to appreciate that these innovations in instruction can be used to do *new* things, to achieve new instructional goals hitherto not achievable. In short, to allow attainment of the missing curriculum.

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EDUCATIONAL MEDIA IN PERSPECTIVE

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Introduction

A common notion about educational technology is that it is only concerned with education media, in particular the operation of equipment to produce or present educational programmes. Unfortunately, many people who claim the title of 'educational technologist' have been happy to accept this rather narrow role. Others, by their actions, which tend to overemphasize the place of educational media in the teaching-learning process, reinforce this narrow view.

One of the factors which has contributed to and reinforced this view of educational technology has been the rapid and continuous developments in the electronics industry since World War II. In the last ten years, many of these developments have found direct application in educational media. The result has been an almost unceasing stream of new and increasingly sophisticated devices flooding onto the education market. One result of this flood of new equipment and its ready availability has been a preoccupation within learned societies like the Australian Society of Educational Technology, in journals, and by individual workers with matters like:

- keeping up-to-date with the new developments in videotape formats and videotape equipment, television cameras (particularly new developments in portable colour cameras), film technology (particularly super 8), micro-electronics and its applications to control equipment and computer facilities;
- assessing manufacturers' claims about the seemingly endless stream of new models and products (many of which are incompatible with earlier models) and how to adapt them for use in instructional settings;

- giving advice on how to use equipment or how to choose between brand X or brand Y of a particular piece of equipment;
- the everyday problems of providing a flexible production and presentation service to support the teaching effort in an institution; and
- telling and demonstrating techniques of operating and utilizing equipment to people with varying amounts of technical competence to enable them to produce and present their own material.

Because one can become so involved in keeping abreast of these rapid, continuous and diverse developments and in solving the myriad everyday problems concerning equipment use and operation, there are real problems for the person who works with educational media in maintaining a perspective about the role of educational media in the education process. The perspective problem is heightened by the fact that some of the media are intrinsically so attractive, so absorbing and compelling that one can become involved in that medium for its own sake. The danger with this level of involvement is that all instructional problems are viewed from the context of that medium. Television and the overhead projector are two examples of media which have this attraction. An unfortunate consequence of the attractiveness of particular media (particularly the hardware aspects of it) is a tendency to seek 'high technology' solutions to educational problems. The explanations for doing so include:

- the 'client' demanded or expected such a solution so why not give it to him;
- the technology is available so why not use it;
- someone with an obsession about a particular medium has convinced people that this is the way to solve their problems;
- it is a good vote catching gesture for politicians to list the pieces of equipment (and their cost) supplied to institutions (this response was particularly prevalent in the 1960's and early 1970's);
- a desire to appear up-to-date by using the latest equipment.

Only too seldom is the reason given that it was the best or most appropriate solution to the educational problem.

There is a need for us to be continually reminded that educational media along with the myriad questions about the selection and use of educational media are only one consideration among the many variables involved in the education process. The thrust of the remainder of this article is an attempt to place concerns about educational media in perspective with the other proper concerns of an educational technologist as he fulfils his function as a facilitator of decision making in the design and implementation of educational programmes.

A course design decision framework

A course design decision framework (see Figure 1) developed recently by the Higher Education Advisory and Research Unit (HEARU) at Monash University (Paget, et al, 1978) is presented as one way of summarizing the educational technologist's role in course design and implementation. This particular decision framework was developed for use in a course design project in agricultural education and has since been adapted for projects concerned with vocational training of ambulance officers, secondary teacher training, training of tertiary teachers and a post-graduate programme for transport engineers.

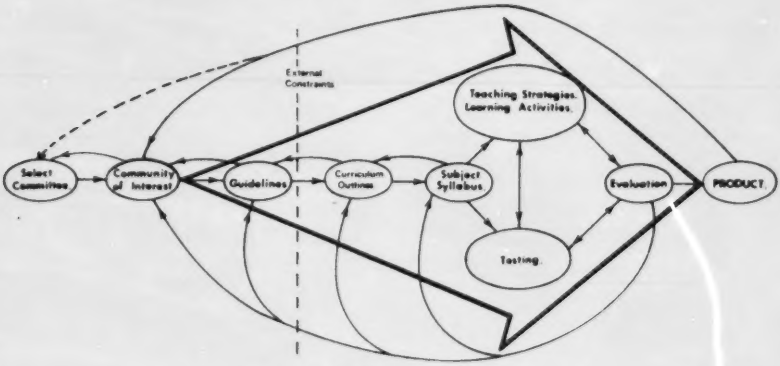

Figure 1 *Course design decision framework*

The decision framework is a logical extension of the well known Gerlach and Ely (1971) systematic approach to instruction combined with an eclectic view of the course design or curriculum decision making process. It thus contains elements of ideas which might be attributable to writers such as Schwab (1969), Owen (1973); Stenhouse (1975), Skilbeck (1976) and others.

The main features of the decision framework presented in Figure 1 are that:

- it indicates that decision making occurs at various 'levels'. The 'levels' correspond roughly with the degree of generality or comprehensiveness of the decisions to be made;
- it implies that it is possible to engage different individuals or groups in the decision making at the various levels and that the responsibilities of the individuals or groups may change at the different levels. No attempt is made to specify who the individuals or groups are or should be, or the organizational structures that can be or should be used in arriving at decisions - since the diagram is *not* an attempt to propose a model or describe a model for the course design - implementation process;
- it implies an interaction between decisions at the various levels, but does not propose or indicate any mechanism to bring about the interaction;
- it emphasizes the importance of evaluation in the decision making process and suggests possible feedback loops to facilitate and to emphasize the continuous nature of the process. (It is appropriate to stress that the diagram is a decision framework and not a model of a process that proceeds along clearly defined steps. Decision making in course design is not contingent on the point of entry to the process or on any particular order of steps. One can derive a logical order of steps and interactions from this diagram if there is a need or an inclination to do so);

. it illustrates the relative importance of decisions about educational media in the course design-implementation process.

There is a whole universe of decision making processes external to the course design process which influence the possible outcomes of the process through the imposition of constraints. The placing of the dotted line across the diagram in Figure 1 is a reminder that course design decision making cannot occur entirely *in vacuo*.

In the remainder of this paper, comments are made about the kinds of decision that might be made at each of the levels indicated in Figure 1. It should be apparent from these comments that the role of the educational technologist as a facilitator of decision making about course design and implementation extends far beyond considerations relating to educational media.

Initiation of course design-redesign

The motivation to initiate course design-redesign procedures may come from several sources. It may result from a simple response to a minor problem with use of equipment, setting examinations, handling small groups, evaluating some aspect of teaching, or it may come from some pressure to provide an entirely new kind of course offering or a major modification of an existing programme. Wherever the impetus originates it is not uncommon practice for the individual or group who initiated the process to consider that all of the expertise and knowledge needed to solve the perceived problem resides within the initiating group (or *select committee* as it is labelled in Figure 1). This may be true in some instances, but in most cases there are many other people outside the initiating group who may have some interest, real or potential, direct or indirect, in the outcomes of the process and who may have valuable inputs to offer. This wider group of interested persons has been called the *community of interest* in Figure 1.

The important decisions in this initiating phase are:

. to articulate as clearly as possible the need or problem as

perceived by the select committee;

- to define the universe of people (community of interest) with inputs relevant to the problem or need; and
- to devise and initiate procedures to involve the community of interest (or a representative sample of it) in the course design process.

Establishing guidelines

Decision making at this level is primarily concerned with board matters of principle and policy. The principles and policies enunciated at this level will be used as a frame of reference for more detailed decision making at other levels.

Some of the decisions that might be made at this level include:

- establish the extent of the need or problem as identified;
- obtain a clear statement of the basic problem(s);
- assess the representativeness or appropriateness of the community of interest;
- identify outcomes that might be expected from a programme designed to solve the problem;
- establish a priority of expected or desired outcomes;
- identify means of achieving the desired outcomes;
- identify possible or desirable parameters for organizing a programme to achieve the desired outcomes;
- identify the resources (human and material) required or desirable;
- develop policy guidelines on questions like - the type of students to be admitted to the course, the entry requirements to undertake the programme, availability of programme to extra-mural students, inclusion and exclusion policies, remedial, bridging and enrichment programmes, certification policies, duration of the programme, relationship to existing programmes or proposed programmes such as

the possibility of postgraduate awards or training; the type of learning environment desired, and so on.

Decisions at this level are essentially matters of principle and policy, and they are concerned with the identification and evaluation of options and priorities. An important feature of the decision making at this level would seem to be that it should be as creative as possible, untrammelled by inhibiting constraints, and that it should begin with the widest possible range of relevant inputs.

Developing a curriculum outline

Once a set of guidelines has been established (from whatever source and by whatever process) it is necessary to make a detailed analysis of the implications and consequences these guidelines have for mounting a programme. The ultimate task is to produce a detailed statement of the means by which these guidelines can be implemented.

Decisions at this level are concerned with establishing the organizational structure of the programme as a whole. Hence we are concerned with specific decisions about course structures and organization like:

- the use of traditional subject areas as a basis for organizing the subject matter of the programme or the development of new multi-disciplinary and inter-disciplinary arrangements of subject matter;
- the number of such units, subjects or modules necessary for graduation or completion of the programme;
- which units (if any) are compulsory;
- how many options will be offered or supported;
- possible subject combinations to achieve particular ends;
- the sequencing and timetabling of the overall programme;
- detailed prescriptions of prerequisites and co-requisites;
- allocation of the financial and other resources to the various aspects of the programme including bridging, remedial and enrichment programmes;

- the number and type of students that can be admitted to the programme at any time;
- detailed prescription of assessment policies; and
- statements about the actual teaching and learning strategies to be employed in the programme.

Obviously decisions at this level must be tailored to meet practical considerations that are imposed by the financial resources and the physical surroundings provided to mount the programme, that is, there must now be some trade-off between desirable - idealistic principles and what is possible or achievable within the constraints imposed by financial and physical resources.

Decisions about educational media at this level are frequently subordinate to decisions in other areas and depend to some extent on these decisions. They include matters like:

- whether media services should be centralized or decentralized;
- what items of media equipment will be made available in each teaching space (either permanently installed or located in the teaching space or readily transportable to the area) and whether or not specialized areas should be established for particular media, e.g. specific spaces wired for television equipment;
- the allocation of funds for the purchase of hardware/software;
- the extent to which software can be produced in-house or purchased from other sources, and the size and type of production facility that can be supported;
- the design, redesign or modification of teaching space to suit specific programme requirements; and
- conditions for staff/student use of media equipment.

Preparing a subject syllabus

A syllabus is an invaluable planning document and should be prepared for

each unit or subject in a programme and be readily available to anyone concerned with that part of the programme. A syllabus is important for two reasons. Firstly, it is an important historical record of the thinking and decisions that led to this subject or unit being offered as part of the programme. Secondly, it is a detailed statement of intent about the implementation of these decisions in this subject or unit. Since it is a statement of intent, it is not the last word about what will or does happen in the classroom.

The main areas for decision in this important planning stage are adequately summarized in the Gerlach and Ely (1971) systematic approach to instruction. This is an important and useful representation of decision areas because, apart from defining the areas, it also attempts to show how decisions in one area interact with decisions in other areas. A considerable portion of the book is devoted to the relationship of decisions about educational media to other decision areas.

In preparing a subject syllabus, decisions will be made about:

- the specific competencies (knowledge, skills, attitudes, etc.) expected as outcomes;
- the specific content (subject matter and experiences) to be included and the sequence and emphasis of these topics;
- the prerequisite knowledge and skills expected for particular topics;
- possible teaching/learning strategies to be employed in achieving desired outcomes (including bridging, remedial and enrichment strategies);
- standards of achievement expected and the assessment procedures to be used in measuring achievement;
- what aspects of the programme should be subject to evaluation, when, how and by whom;
- what resources are needed or are available to support the programme - including resources specifically for teacher and student use.

Implementation

The ground work for much of the decision making at this level has already been done in the preparation of the subject syllabus. There are, however, an enormous number of detailed decisions that have to be made each time a course, subject or topic is taught, because each situation is unique. There is a wide literature about the decision making that has to be made in the everyday management of learning experiences and activities for a group of students, and I do not propose to add to it here. Suffice to say that decisions about educational media are again only one aspect of the decision making at this level.

At this level of decision making, the central question about educational media is "Which medium shall I (should I) use?" There is again a considerable literature on the selection of educational media (Gerlach and Ely, 1971; Briggs, 1970; Allen, 1967; Gagné, 1975; Holden, 1975). The important feature about most of the literature on media selection is that the answer to the question "Which medium?" is dependent on decisions already made in other areas or in some way limits the range of options in other areas.

Conclusion

This article has attempted to put decision making about educational media in perspective with the other areas and levels of decision making in the course design-implementation process. A course design decision framework has been presented as a means of summarizing areas and levels of decision making in this process. It has been argued that the educational technologist through his function as a facilitator of education decision making in the course design-implementation process is the person best placed to provide and to maintain this perspective for decision making about educational media.

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THE EVOLUTION OF EDUCATIONAL TECHNOLOGY

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Abstract

An emerging field is usually beset with identity crisis problems. Professionals who understand their day-to-day responsibilities often express uncertainty about the field of which they are a part. Pangs of isolation sometimes creep into the feelings of otherwise stable people. These are the signs of professionals in an emerging field and educational technology is no exception.

The feelings of uncertainty and isolation stem from the recency of the field's development and the fact that so few people who serve in the field have been specifically trained to do so. A person who has studied mathematics, chemistry or economics senses the traditions, conventions and intellectual roots of a discipline. Individuals are eventually employed on the basis of their preparation in a specific field. But the educational technologist is a new face on the educational scene who appears to come without the usual credentials of a discipline and, indeed, often emerges from the ranks without any special preparation to do the job for which he/she has been appointed. It is no surprise that, under such circumstances, the educational technologist begins to search for a *raison d'etre*.

This paper will explore some of the origins and more recent developments in educational technology for the purpose of establishing an identity for the field and pointing directions for the future. It will briefly examine some of the historical roots, the contributing fields, current practices and future issues.

Why bother?

Some may argue that there is not much reason to consider the past because the field is new and will advance rapidly regardless of its history. Such arguments should be countered with the contention that a new field evolves for very specific reasons and to understand those reasons is to appreciate the purpose of the field's existence. Educational technology emerged from the concern that teaching and learning needed to be improved. It has never lost sight of this concern.

Some professional educators think that it is necessary to establish the territory of each specialty within the education enterprise so that roles and responsibilities are most efficiently carried out. In doing so, one might ask, "What are the boundaries of educational technology? What unique function do its personnel perform?" While educational technology has been called a movement whose membership is open to all educators who accept and abide by its principles (AECT, 1972) it does possess qualities and characteristics which are unique. (AECT, 1977) Its practitioners are primarily responsible for media management, media product development and instructional program development. (Bergeson, 1973)

As the field becomes more established and professionals are systematically prepared, questions about the content, intellectual techniques and modes of inquiry emerge. In developing a curriculum to prepare educational technologists, it is necessary to define the core competencies which must be acquired by every new professional and to spell out areas of special emphasis within the field.

Where it all began

There are some who maintain that the Elder Sophists were the first educational technologists and there are those who would credit Comenius and his Orbus Pictus (The World in Pictures) as the first evidence of mediated instruction (Saettler, 1968). These precursors, and others over the centuries, provided a background for the major revolution in educational communications that began in the early decades of the 20th Century with the development of lantern slides, motion pictures and radio used in a teaching-learning context. For contemporary educational technologists, the use of these media in educational settings marked the beginning of the field - about fifty years ago.

Contributing fields

The field of educational technology is eclectic. It has no unique body of knowledge which is the sole province of the field. It borrows from many fields and disciplines; reconfigures concepts and produces a kind

of synergy where the whole appears to be greater than the sum of its parts.

There are major contributors and minor contributors. The early audiovisual developments have to be given credit for initiating the movement. They remain today as media - the products or instructional materials which serve as the vehicles for delivery of instruction. The design, production and use of audiovisual media are major contributors to the educational technology field.

Some people's interpretation stops at this point considering "educational technology" to be a new name for "audiovisual education". As the field matured in the 1960's, more emphasis was placed on the psychological bases for media. One contribution to understanding media came from perception psychology (Norberg, 1962) while the contextual use of media was explored from the viewpoint of learning psychology (Meierhenry, 1961). It was in the early 1969's that programmed learning became a strong influence on the emerging field of educational technology. The psychology of learning, which was dominant in programmed learning, was influential in the design and use of audiovisual products and it was this confluence that probably created the field of educational technology as it is known today.

The design strategies which were often necessary for programmed instruction led to a consideration of the systems approach as a technique which would amalgamate the diverse elements of teaching and learning. The field of operations research contributed some of its procedures to educational technology. The process of instructional design (or development) and some of its algorithmic tools stem from systems analysis.

As protocols for designing, developing and using instructional products and processes advanced, questions about efficiency and effectiveness were raised. These concerns led to an interface with the emerging field of evaluation. With the techniques of psychometrics and the

procedures of qualitative research, the field of educational technology embraced evaluation as its quality control method. Rowntree (1976) has suggested that evaluation is "... the unifying activity in which all those calling themselves educational technologists can join together."

Other fields have contributed to educational technology, but in a much less significant fashion. In the design of audiovisual media, contributions have come from aesthetics, graphic arts, photography and cinematography. In the area of instructional development, the psychology of individual behaviour, project management, human relations and pedagogy have each contributed. For those who administer programs in schools and colleges, management is a contributing field as is the the sociological dimension of diffusing innovations.

As educational technology developed as a distinct field, it seemed to impinge upon the perceived territory of other fields. As libraries considered their domain to be the acquisition, classification, storage and retrieval of information regardless of its format, audiovisual media became logical extensions of book collection. Many libraries have assumed these functions often leaving bewildered media specialists behind. When educational technologists broadened their concern for the systematic process of teaching and learning, curriculum specialists felt an incursion into their domain. These issues of territoriality have not been completely resolved, but as the field of educational technology has grown, so has it matured to a point where it can be defined with some degree of assurance. Such definitions help to establish the necessary distinctions between educational technology and other closely related fields.

Current status

Educational technology or instructional technology? In the new AECT Definition and Glossary of Terms (1977), educational technology is defined as "a complex, integrated process involving people, procedures, ideas, devices and organization, for analyzing problems, and devising, implementing, evaluating and managing solutions to those problems,

involved in all aspects of human learning", while instructional technology is a "sub-set of educational technology, based on the concept that instruction is a sub-set of education". It is concerned about "learning (which) is purposive and controlled". The distinction is probably useful. There are still those who cannot make up their minds Apparently the International Yearbook of Educational and Instructional Technology 1978/79 is one such example. It would seem to be most expedient and logical to call the field *educational technology* since "education" is more encompassing than "instruction". If the field is to have any impact on education and society, it must address itself to educational concerns which are beyond the more limited scope of instruction.

Definitions. The definition adopted by the Australian Society of Educational Technology (Hutton, 1976) is in the mainstream of current definitions: "Educational technology (is) the design, application, evaluation and development of systems, methods and materials to improve the process of human learning". Attempts to define the field in the U.S. reflect the continual concern (if not preoccupation) of the profession with its identity. (Ely, 1963; Commission on Instructional Technology, 1970; AECT, 1972; AECT, 1977). Each of the definitions, like the ASET definition, reflect a behavioural science orientation, a systematic approach and a goal of improving learning. We can assume that there is a high degree of agreement on the matter of definition.

Functions. One cannot help but be impressed by the number and variety of positions in the field. In the International Yearbook of Educational and Instructional Technology 1978/79, there are over 250 pages listing centres of activity around the world - names, places, descriptions of activity which all fall within the scope of the field. The nature of job responsibilities is less clear. What do educational technologists do?

The Jobs in Instructional Media Study observed on-the-job performance of media personnel. This analysis, coupled with Silber's ideas

(Wallington, et al, 1971) produced the "domain of instructional technology" which listed nine functions performed by media personnel: organization management, personnel management, research, design, production, evaluation-selection, support-supply, utilization-dissemination. An educational technologist is one who performs one or more of these functions in an educational setting. Heinich (1972) suggests that there are three broad categories of jobs for educational technologists: 1. curriculum and/or instructional design; 2. instructional product design and media production; and 3. management of media services. A survey of current position announcements would confirm these areas of job placement. One other category, which does not fit into Heinich's scheme, is for those who teach educational technology for teacher education or for professional preparation of specialists. There appears to be a sufficient demand for educational technologists to justify programs which prepare professional personnel.

Organizations. The hallmark of any profession is an organization of practitioners which is formed for the advancement of the field and to establish communication among its members. Educational technologists have organized themselves at regional, state and national levels in Australia, Canada and the United States and at national levels in England, Japan and Poland. Each organization provides communication among its members (and other interested persons) through periodical publications. The ASET Yearbook serves that function in Australia; the Association for Media and Technology in Education in Canada (AMTEC) publishes a regular newsletter; and the Association for Educational Communications and Technology (AECT) publishes Audiovisual Instruction and Educational Communications and Technology: a Journal of Theory, Research and Development (formerly AV Communication Review). In England the Association for Programmed Learning and Educational Technology publishes Programmed Learning and Educational Technology.

There is one association which serves the field internationally: the International Council on Educational Media, in which individual countries are members and professionals are "associate" members.

ICEM publishes Educational Media International. The International Film and Television Council is a related body with a close tie to UNESCO and other international education organizations. The IFTC Newsletter is a regular publication.

The growing number of organizations and the increasing involvement of professionals in these organizations augers well for the future of educational technology in each country and worldwide.

Data base. Any profession requires some control over the information generated by professionals in the field. Various countries, through national libraries, and universities, through their libraries, have attempted to acquire and make available information about educational technology. There is only one system which has been established to collect and process research reports, journal articles, conference proceedings and other limited-circulation publications in educational technology - the Educational Resources Information Center (ERIC) Clearinghouse on Information Resources (IR) located at Syracuse University in the United States.

ERIC/IR is one element of a national education information system established in 1966 by the U.S. government and now administered through the National Institute of Education. ERIC/IR concentrates on materials dealing with the management and dissemination of information in the fields of educational technology, library science, and information science.

The focus is on personnel, personnel development, strategies, systems, procedures, materials, and equipment in these areas. Included are the following specific topics: libraries; learning resource centres; information science; instructional design; development and evaluation; systems analysis; community information systems; instructional media; information transfer; mastery learning; simulation and gaming; programmed instruction; individualized instruction; and information brokering.

The Clearinghouse is also concerned with the delivery of information and instruction through media: television; computers; radio; films; microforms; holography; and other audiovisual devices.

Even though the data base originates in the U.S., there is a strong identity with Australia. As of 1978, there are 1337 citations from or about Australia. There are ERIC microfiche documents in at least ten locations in Australia, mostly in libraries of tertiary institutions. The National Library of Australia has established AUSINET - a computer-based information system which can search the ERIC data base. Such a service is available without charge.

The existence of ERIC/IR offers further evidence that the field of educational technology has become established and accepted within the education community.

Research. A final sign of maturity in any profession is a body of research literature which contributes to the advancement of knowledge about the field. From crude, early beginnings (Hoban and Van Ormer, 1950) to a golden decade of educational technology research in the U.S. (1958-1968) while specific research funds were available, the research in the field has become more sophisticated and more programmatic. The research summaries of Molstad (1974) and Torkelson (1968) have summarized the research through the late 1960's. Current research directions are presented by Clark (1975). A critique of educational technology research is lucidly presented by Jamison, Suppes and Wells (1974). Rodwell (1974, 1975) has summarized the recent British research in the field. Much of the current educational technology research is being done by graduate students in colleges and universities, although there is some work being done by and for the military services.

Past research efforts in educational technology have been unduly preoccupied with justification of the field. Other studies have been concerned with media variables. The current interest in aptitude-treatment interaction (ATI) marks another era of educational technology

research. The field still seems to be searching for its mode of inquiry. Of all the characteristics of a profession, the lack of a body of useful research, is most limiting.

Future issues

The future of educational technology has been discussed elsewhere. (Ely, 1976; Chisholm and Ely, 1976). The future of the profession is a matter quite separate from the developments of educational technology in society. The profession has grown and developed over the past half-century because of dedicated professionals who had a vision for what the field could become. They helped to create a place for educational technology in contemporary educational settings. They named and defined the field; they organized and they published. Research was fostered and information about the field was put into a massive data base. All of the elements of a mature profession are in place - and they are still developing.

If the field is to be maintained and to grow, today's professionals will have to make their contributions. The future can be shaped by those who will be a part of it or ... it will be shaped by others who may or may not see a role for educational technology. If others do it, the educational technologist will have to adapt rather than to help create the future.

The issues will remain: definition of the field, functions of the media professional, organizations for professionals, expansion of the data base and quality of research. However, in the long run, educational technology will be judged on its ability to facilitate learning - which is where it all began.

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MICROFORMS: TOOLS FOR LEARNING

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Abstract

Microforms have a broad range of educational uses. As a tool for student learning, they contain curriculum source materials, lecture and laboratory notes, and self-instructional programmed units. Student records and library research materials often utilize this format. This paper reviews these educational applications, outlines the major types of micrographics equipment available and their costs, and describes sample equipment configurations.

Microforms have a wide range of potential uses in primary, secondary and tertiary education. With a minimum investment of approximately $150 in a portable microfiche reader, a school can begin to make use of microform materials. Of course, the greater the investment in equipment, the more options that open up.

The following guide reviews some of the applications of microforms in education, outlines the general types of equipment available and their costs, and describes some hypothetical equipment configurations based on interviews with microform users in South Australia.

Microform applications in the classroom

Of primary interest to the educationist is the use of microforms as tools for student learning. Burchinal (1971) notes that individualization in instruction might well promote increased use of microforms:

> A broad range of materials must be provided in each subject field by a number of grade and comprehension levels. Microforms, along with films, filmstrips, records, videotapes and other media, can share in providing the needed, rich array of information.

Among microforms alone, this array has taken many formats - source

materials produced commercially or in-house notes and references produced to accompany specific courses, multiple copies of texts and other materials for use by external students, student assignments reproduced for shared use, career information, and programmed self-teaching units.

Source materials

A number of primary schools in the United States have integrated microfilmed source materials into their students' learning experiences. For example, microforms were used almost exclusively for basic instructional as well as supplementary materials in a grade three classroom in rural Barrington, New Hampshire, for two years. Text books, lesson plans, reference books, newspapers and stories for pleasure reading were all available. Children easily learned to cope with 20 different readers utilizing fiche, roll film, cassettes, cartridge and ultrafiche. Students worked both individually and in small groups (C. Harmon, 1971). Tests of student performance before and after the project showed gains in reading above the expected norm (C. Harmon, 1971) . Although teachers and students enthusiastically accepted the medium, a number of deficiencies with hardware and software were noted (G. Harmon, 1972).

In Britain, microforms have been used by primary students for the study of local history in areas where public record offices and museum archives were not readily accessible. As a project in the Leicestershire village schools, early travelogues and directories loaned by the county library were filmed and collated with contemporary photographs, in a microfiche format. All were carefully indexed. Children used the 46 fiche to trace institutions and buildings as well as family groups, and in so doing, interested much of the adult community in their searches (Edwards, 1975).

Repp (1975) provides a comprehensive review of the studies related to the use of microforms by primary school children. In her conclusion she states:

Children like to use microfiche. This was reported in every study. Whether this is due to the novelty of the equipment, the similarity of screen reading to television, the sense of power and control a child has in manipulating the machine, the social aspect of two or three children reading together, the appeal of reading pleasure disassociated from the book form (often a symbol of pain and failure to poor readers), some other factor, or a combination of factors, is at present a matter of conjecture.

Microfilm has also been utilized in a variety of ways at the secondary school level. As part of the curriculum at Henry M. Gunn High School, Palo Alto, California, students have been required to use the library's microfilm collection. In studying the United States Civil War, for example, students were given an assignment assessing the views expressed in articles and letters to the editor from microfilmed issues of Harpers Weekly, Southern Confederacy, and Civil War Times (Christine, 1972). A similar programme at White Plains High School, New York, has integrated use of 32 microfilmed sets of periodicals into independent and group projects in social studies, science, and English classes (Cohen, 1973).

In Scarsdale, New York, secondary students have supplemented their American history course with 200 reels of the New York Times on microfilm. Effective use of the microfilm taught students to evaluate sources, and made them far less willing to accept their textbooks at face value. Eric Rothschild (1971), the teacher involved in this experimental programme, stated:

The use of microfilm in the classroom broke the feeling of many students that history was inevitable, that all of it would have happened anyway. As they saw events unfold and pressure points reached in history, the microfilm brought immediacy and even sometimes doubt to the students. Things that were perfectly clear seemed somehow more alive and more complicated than ever before. And that, I believe, is what history is all about.

An indication of the extent to which microfilm had penetrated the secondary school market was sought by Xerox University Microfilms in 1973. To a questionnaire sent to secondary schools throughout the United States, over 1,000 of the 2,500 which replied indicated that

they currently held a collection of microfilm (Whalen, 1975).

At the tertiary level, history courses using microfilmed source materials in a discovery method approach have been taught at Hamline University with the 3M IM/Press Collection of the New York Public Library and at the University of Wisconsin using materials of the Wisconsin Historical Society (Robbins, 1971).

Commercial Suppliers

A wide range of microform source materials is available for classroom and library use from commercial suppliers. University Microfilms has developed and tested a number of integrated microfilm packages: Bridges to Inquiry includes selections from turn-of-the-century periodicals expressing a wide range of opinion and style on topics such as the automobile, conservation, psychology and education (Stern, 1971). Focus on the News consists of complete microfilmed editions of four weekly news magazines from 1811 to date. Xedia, the Micromedia Classroom Library, includes microfiche reproductions of over 1,800 volumes of children's literature, picture books, and curriculum related materials in support of science, social science, and reading instruction in grades one through six. Finally, the National Geographic Magazine in colour microform is available from the first volume in 1888.

Microbook Library Programs, from Library Resources Inc. of the Encyclopaedia Britannica Educational Corporation, is based on titles taken from the 20,000 volume American Civilization Collection. Bell and Howell provides major U.S., U.S.S.R., and other overseas newspapers (Burchinal, 1974; Christine, 1972).

Course notes and references

Microforms, in lieu of slides and photocopies or printed materials, are being increasingly adopted for distribution of notes and readings in support of coursework at the tertiary level. A number of medical and veterinary schools have used microforms, especially colour microfiche,

to augment the laboratory method.

At George Washington University School of Medicine in Washington, D.C. for example, colour microfiche have been used as an adjunctive laboratory method for teaching anatomic pathology. Gross specimens and histologic sections were photographed and assembled in sequence, accompanied by written descriptions, clinical history of the patient, autopsy findings, and a review of the condition depicted (Smith, 1971). Within South Australia, The South Australian Institute of Technology provides colour fiche for courses in medical technology and pharmacy (Thompson, 1978). In these and other institutions, the fiche are projected by the instructor in lecture and used for home study and revision by the students.

Lewis (1976) reviewed the state of the art of microfiche in medical education, describing uses at Ohio State College of Medicine, the University of Washington, Yale University and other major tertiary institutions in the United States. In conclusion, she states:

> That the increased use of black-and-white microfiche will improve the acceptance and availability of color fiche cannot be ignored. Soon, students and others will want color for graphic illustrations and probably the money to support these demands will be found -- even in the present economy -- for many of the same reasons that color television seems like a necessity. Certainly the medical students who need color miniatures will constitute a high priority in our educational media production in the 1980's.

Experimentation with microforms has been carried out in tertiary courses in fields other than the biological and health sciences. In two experiments at the University of Denver in Colerado, the use of ultrastrips was tested in the courses "Information Science and Technology" in the Graduate School of Librarianship, and "Sensation and Perception" in the Department of Psychology. Several thousand pages of materials were filmed, including both texts and journal articles, for use as selected readings and reference sources for research papers (Kottenstette, 1971). A similar study using conventional fiche containing readings for the "Foundation of Librarianship" course was carried out

by the Department of Librarianship at San Jose State University in California. Among the findings was that the microreadings were considered more convenient than the print reference system by two-thirds of the test group (West and Butler, 1974).

External Studies

Providing course materials on fiche has added advantages in external teaching. The University of South Africa, Pretoria, which offers correspondence tuition to over 25,000 students through South Africa, found it difficult for the library to supply *adequate multiple copies* of supplementary texts recommended by lecturers. In addition, mailing books was costly and time-consuming, with the risk of damage. Publishers were approached for permission to make a number of recommended texts available on fiche, with compensation set at 10% of the sale price. Approximately three-quarters of the 70 publishers agreed. The University made master negatives and produced diazo copies for the students, and also purchased microfiche readers for loan to students. Fiche were posted for the duration of the academic year rather than for limited loan periods. Student reactions to the use of fiche were generally positive (Aschenborn, 1972).

Within South Australia, the South Australian Institute of Technology has used microfiche along with audio cassettes as part of a "kit" for teaching social studies at remote locations. Groups of students are visited by lecturers in addition to their using the prepared materials (Thompson, 1978). At Adelaide College of Advanced Education, colour microfiche have been utilized in teaching educational technology courses both externally and internally. In comparing the costs, it was found that a set of 36 slides could be reproduced in-house for $0.90 on fiche versus $4.25 normally. Postage to external students was also reduced using fiche (Dent, 1978).

Distribution of student assignments

Distribution of student papers to be read by class members prior to

seminar or tutorial sessions has been suggested as a further use of microfiche in education. Discussions during class can then be based on students' reactions to the contents of the papers, and the students can retain their copies along with their notes for later study.

Such an application has taken place at Torrens College of Advanced Education in Adelaide, where students enrolled in the curriculum studies course were required to prepare resource lists for teaching units in social studies. These lists were microfilmed as a group, inserted in jackets manually, duplicated and distributed to each class member. Initially there was a problem with resolution in filming, for many students had written in blue biro. This was overcome by requiring copy in black ink or typewritten form. The fiche could be used by the students in the library or at home on portable readers circulated for overnight use. The students each retained their fiche for permanent reference, and in addition, copies were placed in the library for use by subsequent classes (Langrehr and Russell, 1978).

Career information

Microforms have been used quite extensively to supplement counselling and career guidance programmes in secondary schools and in tertiary institutions. Career education materials in the INFOE (Information Needed for Occupational Education) system developed by the Tennessee Research Coordinating Unit have been designed for students from kindergarten through high school. Testing with rural sixth grade students showed they recalled a significantly greater amount of career information when it was presented on microfiche rather than in hard copy (Ahern, 1976).

A vocational information programme using microfiche exclusively has been made available to 20,000 students in 34 counties in Southern Georgia. Entitled HI-JIVE (Job Information for Vocational Exploration), the microfiche information set contains over 2,000 pages of material on over 400 careers. Each job description includes training, entrance requirements and union membership, plus local information on job

opportunities and salary ranges. Participating schools can purchase the packet for a reasonable $US150 (Cone, 1976).

The National Microfilm Library, a non-profit organization located in San Diego, California, provides calendars of over 2,900 tertiary institutions in the United States, United Kingdom, Australia and other countries on microfiche. The set, priced at $US400, has been purchased by over 1,700 secondary schools, tertiary institutions and libraries, for use in counselling students in career decisions (Lane, 1978).

Self-instructional programmes

Self-instructional programmes using microforms have been designed to use a range of equipment from the basic microfiche reader to sophisticated computer-linked retrieval systems. The SIMPLE System (Self Instructional Microfiche Programmed Learning) has been tested at Kilkenny College of Technical and Further Education, Adelaide, in a mathematics course required for the Electrical Technicians Certificate course. This system is described briefly by Todd, Cawthron and Friganiotis (1977):

... Each image or "page" of the microfiche provides information forming a logical step, that is a frame, in a self-instructional programme. The frames of the programme are viewed in turn by the student using a microfiche reader. Each frame directs the student to the next frame, which he manually selects by means of the image locating pointer of the reader. In this way, according to his answers to [illegible]ems posed by the programme, the student may be directed rapidly t[illegible]gh the programme, or through a number of branches which provide him with greater assistance. Ideally, working at his own pace, each student is directed along those branches of the programme that best meet his individual needs.

Results of pre- and post-tests to control and experimental groups indicated that the students using the fiche received scores not significantly different from those taught by conventional methods. However, approximately one-third of the self-paced microfiche students spent less time than those taught in a group lesson.

At the University of Tennessee Medical School, a single self-

instructional colour fiche was developed to teach the fundamentals of malaria. The monetary costs and manhours required for the project proved justified in light of field test data, learner performance and audience acceptance (Burch, et al, 1975).

Microfiche has also been integrated into sophisticated systems of computer-assisted instruction and both the Orange Coast and Golden West Community Colleges in Southern California have utilized fiche called up by computer command on a visual display unit in the COMPCARD System. Retrieval time for the fiche -- colour or monochrome -- varied from 0.2 to 4.0 seconds. Thomas Gripp (1972), Director of Learning Resources at Golden West College, described a typical computer-microfiche course:

> In art history, classical sculpture and artwork are presented in full color on the screen. The student is given a multiple-choice question about its chief characteristics. If the student answers correctly, the computer praises him and gives him the next question. If he types a wrong response, the computer calls up another frame, asks him to compare styles, and explains why he went wrong. Reference also is made to pages in his textbook where he can further study the period.

Besides art history, teachers have designed computer programmes with microfiche visuals in calculus, geometry, graphics, English, political science, symbolic logic, night photography, electronics technology and business law.

Two major corporations have experimented with advanced computer-assisted instruction systems using microfiche for training their personnel. Customer engineers in the Field Engineering Division of IBM were given basic and advanced training in the maintenance and repair of a wide spectrum of IBM products using a printer/keyboard terminal connected to a computer in Poughkeepsie, New York. The CAI programme assigned tasks, questioned the student on completion, analyzed answers and provided remedial assignments if required. In order to use fiche rather than slides or filmstrips for visuals, IBM had to develop an in-house method for preparing and exposing continuous tone materials. From the student's standpoint, the photographs he saw were as good as

he is accustomed to seeing in printed reference material (Filter, 1970).

One of the more advanced interactive programmed learning systems utilizing microfiche was designed and built in the Kodak Research Laboratories. Components of the system included a random access microfiche projector, plasma display screen, random access sound player and keyboard, which were linked through a mini-computer to a time-share computer. The CAI system has been used with several hundred students in a basic training course for Kodak field service people (Goddard, 1976).

Use of microforms with handicapped students

Not only does microform software provide important learning opportunities, hardware can also make a unique educational contribution, especially in the case of handicapped students. G. Harmon (1972) notes this largely untapped potential:

A surprising number of children have visual problems. With microfilm, it is easy to project an image much larger than normal for these children. This capability can also aid the slow readers in the first few grades. Of perhaps even more importance is the use of microfilm for children with dyslexia (the disfunction that manifests itself as a problem with reading); surveys indicated that it may affect 40 percent of all students. Special programs have been generated in this area to use microfilm.

Microfilm readers have also adapted for use by quadraplegic students. They are fitted with a lightweight harness containing wafer switches for chin operation. Required course texts are then microfilmed for student use (Milward, 1972).

Peripheral uses of microform in education

Although major emphasis has been on the use of microforms in teaching and learning, there are peripheral uses of microform in educational administration, library procedures, publication and research.

Administration

Microfilm has long been used for maintaining student records in educational institutions. Documentation of applications in the United States exists from 1950 on for school districts, and primarily from 1970 on for tertiary institutions (Horder, 1975).

Of most current interest is the use of Computer Output Microfilm (COM) in administration. At the University of Wisconsin, Milwaukee, for example, COM output was used to generate the administrative study list, consisting of 21,000 records filmed at 42X reduction. The entire list was contained on 34 4" x 6" microfiche. The University has also converted class lists, grade reports, transcripts, faculty/staff directories, student loan ledgers, accounts payable ledgers, and statistical reports to COM-generated fiche (Sperry, 1971). Temple University has also carried out a major systems study aimed at installing COM, initially to generate student records (Kelley and Wenger, 1970), while Ohio State University has instituted a sophisticated university alumni marketing information system utilizing COM and roll film (Miller, 1972).

Library applications

Microforms are utilized in many library operations: document preservation and storage, cataloguing, interlibrary loan and circulation. Most tertiary libraries maintain a research collection of theses, periodicals and newspapers in microform. The extent of these collections in the United States is outlined by Reichman and Tharpe (1972), and in Australia by Lane (1976). More detailed descriptions of microfilm holdings in major South Australian tertiary libraries are covered by Correll (1976), Stafford (1976) and Mellowship (1976).

Among the Australian tertiary institutions providing complete or partial microform catalogues are the Royal Melbourne Institute of Technology (Stecher, 1975), New South Wales Institute of Technology (Peake, Poole and Wilschefski, 1976), Swinburne College of Technology (Villwock, 1976) and Milperra College of Advanced Education

(Gatenby, 1977). The SAERIS (South Australian Educational Resources Information System) project of the South Australian Education Department School Libraries Branch is the most advanced in Australia, catering for schools with plans to supply microfiche copy of Branch catalogue information to state primary and secondary schools, as well as some independent schools (Harrington, 1978).

NUCOM (the National Union Catalogue on Microfilm), available through the National Library of Australia, is of inestimable value in inter-library loan procedures, to determine locations of materials for researchers in academic institutions.

Publication

Publication of original works is not always economically feasible in hard copy, although it may become so in microform. The University of Queensland Press, for example, lists its currently available microform publications in its *Audio-visual and Microform Catalogue 1977-78*. On a smaller scale, the Library Studies departments at both the University of Adelaide and Royal Melbourne Institute of Technology have published outstanding student projects in limited quantities in microfiche for dissemination nationally.

Research materials

Selected research materials are published internationally in microform, including theses (accessible through *Dissertation Abstracts International* published by University Microfilms International), ERIC (Educational Resources Information Centre) documents on fiche (accessible through *Resources in Education*), and NTIS (National Technical Information Service) reports (accessible through U.S. *Government Reports Announcements*). The National Library of Australia also circulates lists of overseas documents in microfiche, arranged by specified subject areas.

Microfilm is often used to record manuscripts, notes and other archival

materials for historical research, while aperture cards are favoured for collecting and sorting blueprints, working drawings, maps or diagrams for architectural, engineering, or other technical and applied scientific research. Microfiche has been utilized to reproduce personal collections or original or photocopied materials in a compact form to be transported overseas for study leave.

In an unusual application at Torrens College of Advanced Education in Adelaide, lecturers have built up personal sets of fiche on their subject specialties -- including toys and spiders -- by photographing both the objects themselves and colour plates from books, and inserting the film in microthin jackets. These fiche files are used for both teaching and research identification.

Equipment and costs

In the following section, the most common types of micrographics equipment found in schools and tertiary institutions are listed with descriptions of some of their features. These descriptions are generalized, collectively representing a number of pieces of equipment from several different suppliers. It must be emphasized that the features listed may not all be available in any one piece of equipment from any given supplier.

The costs indicated are the lowest basic equipment costs for retail sales, based on discussions with suppliers in May, 1978. Additional discounts are available to specified educational purchasers. However, in general, the greater the number of optional features provided, the greater the expense.

Portable microfiche readers

- May handle microfiche, aperture cards or microfilm jackets
- 20x to 40x magnification
- Up to 3 lens
- Changeable grid index guides
- Range in size from pocket to brief case (weight 5 lbs up) models

- Battery or powerpoint operation
- Screen, table top or wall projection
- COST: Small portable models, $115 - $150
  Brief case models, $150 - $250.

Microfiche Readers/Reader-Printers

- May handle negative or positive microfiche, aperture cards or microfilm jackets
- Various screen sizes, for single or double page viewing
- Various non-glare screen colours
- Front or rear projection
- Single, dual or interchangeable drop lenses
- Changeable grid index guides
- Table top or floor stand
- Automated random access retrieval units (holding up to 30 fiche per cartridge with interchangeable cartridges)
- COST: Readers, $185 - $300 and up
  Reader-printers, $1,200 - $1, 600 and up

Microfiche duplicators

- Reproduce from microfiche or microfilm jackets
- Utilize Diazo, Vesicular or Kalvar film
- May produce up to 500 fiche/hour
- Variable exposure controls
- On-demand or production settings
- No special piping, venting or wiring required
- COST: $2,100 - $2,800 and up

Film Readers/Reader-Printers

- Handle reel, cartridge, or cassette, 16mm or 35mm film
- Adaptors available for aperture cards and microfiche
- Various screen sizes and light intensities
- Interchangeable lenses
- Power zoom lens
- Automatic threading

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- Motorized film advance and rewind
- Variable controlled speeds
- Rotation of projection head to facilitate reading of images irrespective of position or orientation
- Retrieval through meter reading, screen edge marking or automatic page search
- Up to 10 prints/minute
- Repeat copy counter
- Variable print and paper sizes
- COST: Readers, $800 - $2,100 and up
  Reader-printers, $1,815 - $2,100 and up

Planetary cameras

- Photographic surface up to 45" x 63"
- Filming of up to 60 documents/minute
- Variable reduction ratios
- Automatic focusing
- Adjustable top light and back light
- COST: $1,750 and up

Film processors

- May handle 16mm or 35mm film, from 6 inches to 215 feet in length
- May handle 1 to 6 film strands simultaneously
- Self-threading
- Processing speeds up to 1.5 metres/second
- May handle variable film types (negative, positive)
- Ready to use solutions
- COST: $4,200 - $4,700 and up

Jacket loaders

- Unitize 35mm or 16mm roll film
- Update with single or multiple image additions
- Various size viewing screens
- COST: $1,300 and up

Other types of equipment mentioned previously but not described here include step and repeat cameras, flow cameras, enlarger-printers, and COM (Computer Output Microfilm) units.

Equipment configurations

Over the past twenty years, the choice of equipment has gone from too little to too much. Systems configurations are anything but standardized. The following hypothetical examples, based very roughly on existing or proposed systems in South Australia, are indicative of the types of uses to which a given configuration may be put. All are at a small or medium scale, primarily suited to local or regional operations.

School resource centre

1 table top reader
3 portable reader/projectors

The table top reader, located in the library, is used for extracting catalogue information available from SAERIS. It can also be used by teachers for selecting colour microfiche "slides" for projection during lessons, or reading ERIC microfiche useful in higher degree courses in which they may be enrolled. The portable readers can be borrowed by teachers for use for projecting the fiche in the classroom, or for students who wish to learn at their own speed using self-instructional fiche.

TAFE College Media Centre

1 diazo duplicator
20 fiche readers
2 reader-printers
12 portable readers

Technical handbooks, repair manuals, parts catalogues, wiring diagrams, and specialist journals are provided on microfiche for courses in the electronic and mechanical schools. They are either purchased commercially or prepared at a centralized production centre. The fiche are

duplicated on site as required by students, who can read them in the library or borrow portable readers to use them at home. Students are also encouraged to invest in their own readers.

Tertiary Resource Centre

1 planetary camera
1 roll-film reader-printer, with fiche adaptor
1 roll-film reader
10 fiche readers
4 portable fiche readers

The camera is used for in-house filming of course notes and readings accompanying lectures, for copying individual articles for private study, and for distribution of major student assignments to class members and the library. Film is processed locally and loaded manually into jackets. Duplication of the monochrome is done at cost by a nearby institution, while any colour work is sent interstate. Readers are required for the fairly extensive collection of theses, technical reports, and newspapers and periodicals on microfilm and fiche.

Regional Educational Media Production Centre

1 planetary camera
1 diazo processor
1 jacket loader
1 diazo duplicator
2 table top fiche readers

A variety of monochrome microfiche masters are prepared for duplication and distribution to classrooms and libraries in support of the educational curriculum and student counselling. Contents include readings, worksheets, self-instructional units, reference books, career information, etc. In addition, colour fiche are prepared from slide sets, film strips and plates, and duplicated by darkroom colour processing. Copies of previously published materials are made only after copyright negotiations with the distributors.

Materials are generated by in-hourse staff as well as by request from teachers at an at-cost basis. In addition, student records and school accounts are filmed on an at-cost basis upon request by the schools.

Conclusion

The potential for microform use in educational institutions is almost unlimited, from mundane record-keeping to creative curriculum development. However, institutions interested in establishing or expanding micrographics systems should not jump in head first. They must first analyse their own needs and requirements in detail before beginning to think about purchasing equipment. Final decisions on the system to be implemented should be made only after discussions with a number of micrographics suppliers. Names and addresses of suppliers can be obtained through the Micrographics Association of Australia, GPO Box 1447, Adelaide, South Australia, 5001.

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